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Amtd. dated November 17, 2005
Reply to Final Office Action of September 23, 2005
Docket No: UMJ-116-E (UM-2172 p3)

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REMARKS

Entry of the foregoing amendments to the application is requested on the grounds that the claims, as amended, patentably distinguish over the cited art of record or, alternatively, place the application in better condition for appeal. The claims more particularly point out and distinctly claim the subject matter which Applicants regard as the invention. No new issues have been added which would require further consideration and/or search, nor has any new matter been added. The claims as amended are believed to avoid the rejections applied in the Final Office Action for reasons set forth more fully below.

The Final Office Action of September 23, 2005 has been received and carefully reviewed. It is submitted that, by this communication, all basis of rejection are traversed and overcome. Upon entry of this communication, Claims 1-3, 5, 6, 8-21, and 23-42 remain in the application. Claims 4, 7, 22, and 43-46 have been cancelled. Reconsideration of the claims is respectfully requested.

Claims 1-3, 5, 6, 8-21, and 23-42 stand rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The Examiner states that there is no support in the specification for the pretreatment step. The Examiner's attention is directed to the specification at least at page 11, lines 8-24, which fully supports the pretreatment step. As such, the Applicants assert that the rejection based upon 35 U.S.C. 112, first paragraph, is erroneously based, and withdrawal of the same is requested.

Claims 1-3, 5, 6, 8-21, and 23-42 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicants regard as the invention. Specifically, in claim 1, the Examiner states that term "dehydrated" is indefinite since it is unclear how it is dehydrated, such as by drying, centrifuge, or heating.

Applicants do not acquiesce to the Examiner's rejection. However, in order to expedite prosecution, Applicants have amended claim 1 to recite that the dehydrated adsorbent "is dehydrated via heating." Support for this revision may be found in the specification as filed, at least at page 11, lines 8-16. As such, Applicants respectfully submit that the rejection under 35 U.S.C. 112, second paragraph, of claim 1, and those claims depending ultimately therefrom, has been traversed and overcome.

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Furthermore, Applicants respectfully disagree that the term dehydrated is indefinite in regards to claims 9, 27, and those claims depending therefrom. The Examiner's attention is drawn to the text of both claims 9 and 27, each of which states in part:

... pretreating an adsorbent to form the dehydrated adsorbent, the pretreatment process comprising the steps of: activating the adsorbent at a temperature between about 250°C and about 600°C in at least one of a dry air atmosphere, air, an inert atmosphere and a reducing atmosphere for an amount of time ranging between about zero hours and about 20 hours; and then cooling the adsorbent in at least one of a dry air atmosphere, air, and inert atmosphere. (*emphasis added*)

Applicants respectfully submit that claims 9 and 27 recite that the dehydrated adsorbent is formed via calcining. As such, the Applicants assert that the rejection based upon 35 U.S.C. 112, second paragraph, is erroneously based, and withdrawal of the same is requested.

Claims 1, 2, 19, 21, 25 and 26 stand rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over Michlmayr (U.S. Patent No. 4,188,285). The Examiner states that Michlmayr discloses a process of removal of thiophenes from gasoline by contacting the feed with an adsorbent which is silver exchanged faujasite zeolite, namely silver-Y zeolite. The Examiner states that Michlmayr does not disclose whether the sorbent is dehydrated or not. The Examiner concludes, however, that it would have been obvious to one skilled in the art to have modified the Michlmayr process by dehydrated the sorbent (if wet) since it is "non-sense" to use a wet sorbent for the process.

Further, the Examiner admits that Michlmayr is silent as to the mechanism of how thiophene is bound to the adsorbent. The Examiner asserts, however, that it is expected that the silver-Y zeolite adsorbent of Michlmayr is inherently bound to thiophene by π -complexation. The Examiner goes on to state that it is expected that the Michlmayr adsorbent can inherently adsorb more than 1 mmol/gram of thiophene since the adsorbent of the claimed process and the one of Michlmayr are similar.

Applicants agree that Michlmayr does not explicitly state that the sorbent is not dehydrated. Applicants respectfully submit, however, that a sorbent remains fully hydrated if it is not exposed to some form of heating (or other dehydration process) prior to use. The Examiner's attention is directed to the Declaration that is filed herewith pursuant to 37 C.F.R. 1.132, which generally states that higher sorbent treatment temperatures will remove more water molecules, thus exposing further cationic sites for π -complexation. One skilled in the

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art is cognizant of the fact that if one does not dehydrate zeolites at temperatures at or above about 350°C, they remain partially or fully hydrated.

Zeolites have a strong affinity for water, and some molecules are tenaciously held. The presence of adventitious water will affect the cation coordination in the zeolites, as determined through powder diffraction analysis, and the adsorption of guest molecules, as measured by adsorption isotherms. Furthermore, dehydration conditions strongly influence the formation of silver clusters. To separate these effects, the atmosphere, temperature, and length of time of dehydration were rigorously controlled.

(see Hutson et al., "Silver Ion-Exchanged Zeolites Y, X, and Low-Silica X: Observations of Thermally Induced Cation/Cluster Migration and the Resulting Effects on the Equilibrium Adsorption of Nitrogen" *Chem. Mater.*, **12**, 3020-31, 3022 (2000); previously cited in Applicants' Information Disclosure Statement submitted on June 10, 2004).

As stated in the Declaration, "due to the nature of the cationic species, the water molecules that are left behind are generally bound to cations, which binding inhibits or blocks π -complexation interactions between the transition metals and the aromatic sulfur compounds at those cationic sites (i.e. the cationic sites having water molecules bound thereto)." Applicants point out that sorbents treated at about 250°C are partially dehydrated, and that π -complexation occurs at the dehydrated sites. In sharp contrast, Michlmayr does not teach any heating, or other dehydration of the sorbent prior to use, as such, he implicitly teaches that the sorbent is **FULLY hydrated**, and thus is incapable of π -complexation.

Applicants respectfully disagree with the Examiner's assertion that the Michlmayr adsorbent is inherently bound to thiophene by π -complexation. To facilitate π -complexation, a dehydrated adsorbent, as recited in Applicants' amended claim 1, is used. If water molecules remain in the adsorbent, π -complexation will not occur at sites that are binding water molecules. Michlmayr does not teach or suggest that the adsorbent is dehydrated, as such, it is not inherent that the binding of thiophene to the Michlmayr adsorbent would occur via π -complexation. Applicants respectfully disagree that it would be "non-sense" to use a wet, or a dry but not dehydrated, sorbent for adsorption of sulfur, because a wet or a dry, but not dehydrated, sorbent (such as that taught in Michlmayr) will adsorb, just not via π -complexation. Since Michlmayr does not teach or suggest that the adsorbent is dehydrated, it is not inherent that the binding of thiophene to the Michlmayr adsorbent would occur via π -complexation.

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Further, Applicants respectfully disagree with the Examiner's assertion that the Michlmayr adsorbent inherently adsorbs more than 1 mmol/gram of thiophene. Michlmayr teaches that the sulfur capacities range from 0.07 wt.% to 0.15 wt.% for Ag-Y, with a maximum of 0.2 wt.% (0.0238 mmol/g) (see Examples 1 and 2). It is submitted that the lower sulfur capacities described in Michlmayr result, at least in part, from water molecules remaining in the zeolite. As previously stated, Michlmayr does not teach or suggest that the adsorbent is dehydrated. As such, it is not inherent that a non-dehydrated adsorbent would adsorb as much thiophene/thiophene compounds (over 40 times more than that taught in Michlmayr) as the dehydrated adsorbent recited in Applicants' claim 1.

As such, it is submitted that the Michlmayr reference does not teach or suggest a dehydrated adsorbent capable of π -complexation as recited in Applicants' invention as defined in claim 1.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claim 1 and those claims ultimately depending therefrom is not anticipated, taught or rendered obvious in view of Michlmayr, either alone or in combination, and patentably defines over the prior art.

Claims 3 and 20 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr. The Examiner asserts that Michlmayr does not disclose that the silver exchanged Y zeolite is Ag(I)Y. The Examiner states, however, that it would be obvious to one skilled in the art to have modified the Michlmayr process by using Ag(I)Y, since it is expected that using any silver exchanged Y zeolite would yield similar results. The Examiner also admits that Michlmayr does not disclose that the gasoline is unleaded. However, the Examiner asserts that it would have been obvious to have modified the Michlmayr process by using unleaded gasoline.

Reiterating the arguments above with regard to Michlmayr, Applicants respectfully point out that Michlmayr does not teach an adsorbent that is capable of π -complexation. As such, it would not be obvious to modify the Michlmayr zeolite and to expect similar results, as the sorbents used are not the same. Further, as the adsorbent of Michlmayr is not the same as that used in Applicants' process, one would not be led to modify the gasoline of Michlmayr's process. Even if such a modification were obvious, one would not render Applicants' invention, as the Michlmayr process does not involve π -complexation.

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For all the reasons stated above, it is submitted that Applicants' invention as defined in claims 3 and 20 is not anticipated, taught or rendered obvious by Michlmayr, either alone or in combination, and patentably defines over the prior art.

Claim 5 stands rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Tsybulevskiy et al. (2002/0009404). The Examiner admits that Michlmayr does not disclose a carrier for the adsorbent. However, the Examiner states that Tsybulevskiy discloses an adsorbent also containing a binder, such as silica. The Examiner concludes that it would have been obvious to one skilled in the art to modify the process of Michlmayr by including a binder in the adsorbent to arrive at Applicants' invention, since it is expected that this would increase the strength of the adsorbent. The Examiner further concludes that once the silica was selected, metals are expected to cover the binder.

Applicants respectfully submit that the combination of Michlmayr and Tsybulevskiy does not render Applicants' invention as defined in claim 5. Reiterating the above arguments, Michlmayr does not teach adsorbing thiophene or thiophene compounds via π -complexation.

The process taught in Tsybulevskiy actually teaches away from π -complexation by specifically stating that the selectivity was through physical adsorption—see Page. 3, paragraph [0036]:

These higher molecular weight sulfur compounds are then adsorbed by these synthetic faujasites. The physical adsorption of these sulfur compounds on zeolites is increased, due to their higher molecular weight. Because the adsorption of the sulfur compounds on the synthetic faujasites of the present invention is a two-stage process, i.e., first catalytic conversion of sulfur contaminated compounds, followed by physical adsorption of the catalytically converted products, these synthetic faujasites which are the subject of the present invention are termed "adsorbent-catalyst." (*emphasis added*).

Applicants respectfully submit that Tsybulevskiy does not teach or even inherently show the possibility of adsorbing through π -complexation. As such, the Examiner's suggested combination does not render Applicants' invention as defined in claim 1 (from which claim 5 depends), which recites preferential adsorption via π -complexation.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claim 5 is not anticipated, taught or rendered obvious by Michlmayr and Tsybulevskiy, either alone or in combination, and patentably defines over the prior art.

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Claim 6 stands rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Tsybulevskiy et al., and further in view of Satokawa et al. (2001/00014304). The Examiner admits that Michlmayr does not disclose that the silver is silver nitrate. However, the Examiner states that Satokawa discloses an adsorbent containing silver nitrate that is used for thiophene adsorption. The Examiner concludes that it would have been obvious to combine the teachings to render Applicants' invention as defined in claim 6.

As previously stated, the combination of Michlmayr and Tsybulevskiy does not render an adsorbent capable of π -complexation, as recited in Applicants' claim 1 (from which claim 6 ultimately depends). Furthermore, Satokawa teaches an adsorbent for the removal of sulfur from natural gas. Applicants respectfully submit that one skilled in the art is cognizant of the fact that natural gas and gasoline are different, and that gas is generally easier to work with than liquids. As such, it is not obvious that an adsorbent suitable for removal of sulfur from a natural gas would be suitable for removal of sulfur from liquid gasoline.

Assuming *arguendo* that one skilled in the art would combine the suggested references, the combination would not render Applicants' invention as defined in claim 6, as none of the cited references teach the preferential adsorption of thiophene/thiophene compounds by π -complexation.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claim 6 is not anticipated, taught or rendered obvious by Michlmayr, Tsybulevskiy, and Satokawa, either alone or in combination, and patentably defines over the art of record.

Claims 8-10, 14-17, 23, and 24 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Milton (U.S. Patent 2,882,244). The Examiner states that Michlmayr discloses a process of removal of thiophenes from gasoline by contacting the feed with an adsorbent which is silver exchanged faujasite zeolite, namely silver-Y zeolite. The Examiner admits that Michlmayr does not disclose how to activate and regenerate the spent adsorbent. The Examiner states that Milton discloses activating and regenerating a molecular sieve adsorbent used for removing thiophene by raising the temperature. The Examiner also notes that Milton discloses that nickel can be used as a cation of the adsorbent. As such, the Examiner asserts that it would have been obvious to modify the adsorbent according to Milton's method to optimize the life of the adsorbent.

Assuming *arguendo* that it would be obvious to combine the teaching of Michlmayr and Milton, one would not render Applicants' invention as defined in claims 8-10, 14-17, 23,

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and 24. Neither Michlmayr nor Milton teaches an adsorbent that preferentially adsorbs thiophene and/or thiophene compounds via π -complexation. Milton '244 itself teaches away from such π -complexation (and certainly shows that such is NOT inherent from its disclosure), by specifically stating that the selectivity was through kinetics--see Col. 10, lines 16-18:

Activated zeolite X on the other hand, exhibits a selectivity based on the size and shape of the adsorbate molecule (emphasis added).

Thus, Applicants respectfully submit that Milton '244 does not teach, suggest or even inherently show the possibility of having an enhanced capacity for thiophene/thiophene compounds through π -complexation or any other specific solute-surface interactions. In sharp contrast, Applicants' invention as defined in claim 1 (from which claims 8-10, 14-17, 23 and 24 ultimately depend) recites that the dehydrated adsorbent includes at least one of a metal and metal ion adapted to form π -complexation bonds with thiophene/thiophene compounds, with the preferential adsorption occurring by π -complexation.

As such, it is submitted that it would not be obvious that the activation and regeneration processes for an adsorbent that does not π -complex (described in Milton) would be useful for an adsorbent (such as that recited in Applicants' claim 1) that is capable of π -complexation.

For all the reasons stated above, it is submitted that Applicants' invention as defined in claims 8-10, 14-17, 23 and 24 is not anticipated, taught or rendered obvious by Michlmayr and Milton, either alone or in combination and patentably defines over the art of record.

Claims 11-13 and 18 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Milton, and further in view of Satokawa et al. The Examiner states that Michlmayr does not disclose that copper is used as the cation. However, the Examiner states that Satokawa discloses an adsorbent containing copper that is used for adsorbing thiophene. The Examiner concludes that it would have been obvious to one skilled in the art to have modified the Michlmayr process by using copper as the cation since Satokawa discloses that his adsorbent exhibits excellent absorptivity of sulfur compounds.

As previously stated, none of the cited references disclose an adsorbent that is capable of π -complexation. As such, the suggested combination would not render Applicants' invention as defined in claim 1, from which claims 11-13 and 18 ultimately depend. The use

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of a copper cation in an adsorbent that is not capable of π -complexation would not lead one skilled in the art to use copper in an adsorbent that is capable of π -complexation.

For the reasons stated above, it is submitted that Applicants' invention as defined in claims 11-13 and 18 is not anticipated, taught or rendered obvious by Michlmayr, Milton, and Satokawa, either alone or in combination, and patentably defines over the art of record.

Claims 27-29, 31-34, and 38-42 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Milton, and further in view of Tsybulevskiy et al. The Examiner states that Michlmayr discloses a process of removal of thiophenes from gasoline by contacting the feed with an adsorbent which is silver exchanged faujasite zeolite, namely silver-Y zeolite. The Examiner admits that Michlmayr does not disclose how to activate and regenerate the spent adsorbent. However, the Examiner asserts that Milton discloses how to activate a molecular sieve adsorbent used for removing thiophene by raising the temperature. The Examiner concludes that it would have been obvious to have modified the Michlmayr process by using Milton's method to activate the adsorbent. Further, the Examiner notes that Milton discloses that nickel can be used as a cation of the adsorbent.

The Examiner admits that Michlmayr is silent as to the mechanism of how thiophene is bound to the adsorbent. However, the Examiner states that it is expected that the silver-Y zeolite adsorbent of Michlmayr is inherently bound to the thiophene by π -complexation since the adsorbent of the claimed process and the one of Michlmayr are similar. The Examiner further notes that it would be expected that the Michlmayr adsorbent could inherently adsorb more than 1 mmol/gram of thiophene. Again, the Examiner admits that Michlmayr does not disclose unleaded gasoline nor that the silver exchanged Y zeolite is Ag(I)Y. However, the Examiner asserts that both of these would have been obvious. The Examiner further admits that Michlmayr does not disclose a carrier for the adsorbents. However, the Examiner asserts that it would have been obvious to use the binder, such as silica, as taught in Tsybulevskiy in the process of Michlmayr.

The combination of Michlmayr, Tsybulevskiy, and Milton does not render Applicants' invention as defined in any of claims 27-29, 31-34, and 38-42. Reiterating the above arguments, none of the cited references teach adsorbing thiophene or thiophene compounds via π -complexation. Tsybulevskiy and Milton actually teach away from π -complexation, and Michlmayr does not disclose a dehydrated adsorbent capable of π -complexation.

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For all the reasons stated above, it is submitted that Applicants' invention as defined in claims 27-29, 31-34, and 38-42 are not anticipated, taught or rendered obvious by Michlmayr, Milton, and Tsybulevskiy, either alone or in combination, and patentably defines over the prior art.

Claims 30 and 35 stand rejected under 35 U.S.C. 103(a) as being obvious over Michlmayr in view of Milton, further in view of Tsybulevskiy et al., and still further in view of Satokawa et al. The Examiner states that Michlmayr does not disclose that copper is used as the cation. However, the Examiner asserts that Satokawa discloses an adsorbent containing copper is used for adsorbing thiophene. The Examiner concludes that it would have been obvious to modify the Michlmayr process by using copper as the cation, since Satokawa discloses that his adsorbent exhibits excellent adsorptivity of sulfur compounds.

Assuming *arguendo* that one skilled in the art would combine the suggested references, the combination would not render Applicants' invention as defined in claims 30 or 35, as none of the cited references teach the preferential adsorption of thiophene/thiophene compounds by π -complexation.

For all the reasons stated above, it is submitted that the Applicants' invention as defined in claims 30 and 35 is not anticipated, taught or rendered obvious by Michlmayr, Milton, Tsybulevskiy, and Satokawa, either alone or in combination, and patentably defines over the art of record.

Examiner's Response to Applicants' Arguments

1. The Examiner states that Applicants' declaration that Michlmayr's sorbent is not dehydrated is not persuasive since Applicants do not indicate where in the Michlmayr patent it is disclosed that it is a non-dehydrated sorbent. The Examiner asserts that this is a conclusion without proof from Applicants. The Examiner then states that "Michlmayr's sorbent must be a dry one since it is non-sense to use a wet sorbent for the process."

A. *Applicants' answer to Examiner's Response 1.* Applicants submitted a Declaration by Ralph T. Yang, Ph.D., an expert in the relevant art, stating that Michlmayr's adsorbent is not dehydrated. A Declaration pursuant to 37 C.F.R. 1.132 is considered evidence. To still further substantiate Dr. Yang's Declaration, as shown in the arguments above, if Michlmayr did not state that his sorbents were dehydrated, by the nature of zeolites, the skilled artisan recognizes that the sorbents are hydrated.

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It is submitted that the Examiner's statement that "Michlmayr's sorbent must be a dry one since it is non-sense to use a wet sorbent for the process" is an unsubstantiated, conclusory statement. Applicants request that the Examiner provide a technical reference and/or a patent reference including scientific proof of such "non-sense;" otherwise it is submitted that the Examiner's unsupported statement has NOT rebutted Dr. Yang's Declaration and the further evidence gleaned from the Hutson et al. paper cited above.

2. The Examiner states that the argument that Tsybulevskiy teaches away from π -complexation is not persuasive since Applicants do not claim how the carrier is bonded with the sulfur compound, but state that the metal has this kind of bonding.

B. Applicants' answer to Examiner's Response 2. Applicants respectfully submit that the Examiner's assertion is not accurate. Claims 5 and 27 recites that the carrier has the monolayer of a metal compound dispersed at least partially thereon, and that the metal compound releasably retains the thiophene/thiophene compounds. As such, Applicants do recite that the carrier bonds the thiophene/thiophene compounds via π -complexation with the metal/metal ion. In sharp contrast, the adsorbant of Tsybulevskiy teaches adsorption via physical adsorption.

3. The Examiner states that the argument that Satokawa teaches an adsorbent for removing sulfur from a gas not a liquid is not persuasive since it is expected that in any environment – liquid or gas – the Satokawa adsorbent can remove thiophene.

C. Applicants' answer to Examiner's Response 3. Applicants again respectfully submit that the Examiner's statement is unsupported by scientific fact or evidence. It is well known that chemistry is an "unpredictable" art. As such, Applicants request that the Examiner provide a technical reference and/or a patent reference including scientific proof that the environment of adsorption (liquid or gas) has no impact on adsorption of thiophene; otherwise it is submitted that the Examiner's unsupported statement has NOT rebutted Applicants' arguments.

In summary, claims 1-3, 5, 6, 8-21 and 23-42 remain in the application. It is submitted that through this communication, Applicants' invention as set forth in these claims is now in condition for suitable for allowance. Should the Examiner believe otherwise, it is submitted that the claims as amended qualify for entry as placing the application in better form for appeal.

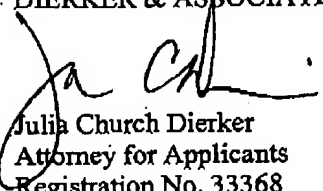
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If the Examiner believes it would expedite prosecution of the above-identified application, he is cordially invited to contact Applicants' Attorney at the below-listed telephone number.

Respectfully submitted,

DIERKER & ASSOCIATES, P.C.



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